Subaru and the American Association for the Advancement of Science are proud to provide you with this Science Activity Booklet.
Subaru and AAAS invite you to bring science into your daily life with these five resources that offer kids the opportunity to learn fun science concepts by conducting their very own science experiments. The activities are designed to be comfortable for non-scientist adults to supervise, to utilize materials found around the home, and to be flexible for time, space, and number of participants.

The activities included here are adapted from a collection of informal, hands-on afterschool resources developed by AAAS for the Science NetLinks website. Each one includes a facilitator page, as well as online and printable pages for kids. More activities can be found at http://sciencenetlinks.com/afterschool-resources/.

This booklet also contains a short guide to citizen science projects in which kids, families, and community groups can participate. These projects are research collaborations between scientists and volunteers that welcome public participation to help collect and sort scientific data for ongoing scientific research projects.

About AAAS

Founded in 1848, the American Association for the Advancement of Science (AAAS) is an international, nonprofit organization dedicated to advancing science, engineering, and innovation for the benefit of all people. With more than 120,000 individual members in more than 91 countries, AAAS is the world’s largest multidisciplinary scientific society and a leading publisher of cutting-edge research through the Science family of journals. As one of the top voices for science worldwide, we spearhead initiatives in policy, international cooperation and diplomacy, STEM education, public engagement, and more. We strive to promote and defend the integrity of science and its use, provide a voice for science on societal issues, and strengthen and diversify the science and technology workforce. More information is available at www.aaas.org.
By the Light of the Moon

If the Moon is just a big hunk of rock, where does moonlight come from? The answer is the Sun!

Sunlight reflects off the surface of the Moon, so we can see it from the Earth. In this experiment you'll see why the moon goes from full to dark and back again.

Let's see how sunlight reflects off the moon!

Here's what to do:

1. Find a partner to work with. Choose one person to be the Sun, and the other to be the Moon.
2. Carefully push the pencil or a stick into the ball, like a lollipop. The ball represents the Moon.
3. Stand about 5 to 10 feet apart. Face each other.
4. If you are the Earth, hold the Moon in front of you at arm's length, just above your head. If you are the Sun, hold the flashlight above your head and shine it EXACTLY on the Moon (the foam or rubber ball).
5. Turn out the lights. Pull down the window shades if you need to, to darken the room.
6. If you are the Earth, describe what the Moon looks like now.
7. If you are the Earth, start turning slowly in place, away from the Sun. Be sure that the Moon is still held out in front of you. (Turn like a top, but very slowly.)
8. If you are the Sun, stand still. Shine the flashlight exactly on the Moon at all times.
9. If you are the Earth, describe what you see as you turn. Pause every couple of seconds and look at the Moon. What kind of a Moon is it now? Do this until you've turned all the way back to where you started. Switch roles and repeat the activity. Now you can explain in words why the Moon looks different at different times. What would happen if the Moon didn't revolve around the Earth?

Here's more about the phases of the moon:

It takes about 29 and a half days for the Moon to circle the Earth. That's how long it usually takes to see all the phases of the Moon. There are times, however, when we can see all the phases of the moon in just a few hours! That happens during a total lunar eclipse -- when the Earth is between the Sun and the Moon, and the Moon passes perfectly through the Earth's shadow.
Dances with Bees

A honeybee hive needs a lot of honey, and that means a lot of flower nectar. When a scout bee finds flowers, she (almost all bees are shes) goes back to the hive to tell the other bees where the flowers are. How does she tell them? She dances!

If a scout bee performs a Round Dance, the other bees know there are flowers very near the hive.

A Waggle Dance means there are flowers far from the hive. But where are they?

Can you do a dance that will explain where to find food? Give it a try!

Let's try a waggle dance!

Here's what to do:

1. Pick a hive area in the room, where all the bees hang out.
2. Choose one person to be the scout bee. That person should secretly hide the flower somewhere in the room where no one can see it.
3. The scout bee goes back to the hive and performs a Waggle Dance that will tell the other bees where the food is. The diagram at right shows the dance steps.
4. Perform the dance so that the "waggle line" (steps A and C) points to the food. The speed of your waggle tells how far the food is -- waggle fast if the food is close (honeybees can waggle 15 times per second).
5. The other bees in the hive should observe the dance and then fly off to see if they can find the food. Did the scout bee's dance help them find it?
6. Next, have someone else try being the scout bee!

Here's more about bee dancing:

Inside a bee hive, where scout bees do their dancing, it is completely dark. So how do the other bees figure out the dance? They take turns holding on to the scout bee while she performs, and are able to feel what the dance is communicating. When the scout performs the dance quickly and includes lots of waggles, the flowers are very near the hive. The dance also shows what direction the food is. Performing it straight up the walls of the hive means the flowers are in the direction of the sun. If food is 30° to the right of the sun, the scouts perform the dance 30° to the right of straight up. It's kind of like a dance on a compass!
Metal Minds

Today, robots don't usually look like the metal creatures you sometimes see in the old movies. A robot can be any machine controlled by computers to carry out a physical task.

What would it be like to have a robot that YOU could control? Try this experiment and find out!

Let's control a robot!

Here's what to do:

1. Pick a partner. One of you will be the robot; the other will be the controller. The controller will command the robot to do a simple set of tasks, like picking up a pencil, walking across the room, and placing the pencil on a desk.

2. Controller:
   First, think of a task for your partner — the robot — to perform. Instead of telling the robot what to do, write a "program" for the robot to follow. Write down all the steps and give these directions to your partner. The tasks will be done without you or your partner talking, so every step in the written "program" counts!

3. Do the same task again, this time using remote control. Use your voice as the remote control and give step-by-step directions for the robot to follow. It is like a very exact game of "Simon Says." The commands may sound like this:

   Take 2 steps. Open your fingers and put your hand on the pencil.
   Bring your thumb and fingers together to grab the pencil. Lift up your arm.

4. The robot should do only what the controller says! Write down what you say so you can compare the two different ways of giving directions. When you are done, switch places and start over!

   How many steps does it take for the robot to complete a task with remote control?
   How many with the program? Did you forget to include any steps with either one?

Here’s more about robots:

There are two ways engineers tell robots what to do. One kind of robot works by "tele-operation." That's when a person (called an engineer) uses remote control to move parts of the robot as it carries out its task. The other kind of robot follows commands from a computer program. These robots are given all of the steps at once, and the program lists every step needed to carry out a task. So the robot follows directions on its own. Which kind of robot did you like better?
Sensational Sound

Have you ever noticed how great your voice sounds when you sing in the shower? Your voice sounds louder and sort of echoes. That's because the sound waves from your voice bounce off the hard surfaces in the bathroom.

And it's amazing how loud your footsteps sound in a school corridor -- especially when you're late for class!

Let's make a Hanger Clanger!

Here's what to do:

1. Cut two pieces of string, each about 2 feet (60 cm) long.
2. Attach each string to a paper cup: First tie a paper clip onto an end of each string. Then, poke a hole in the bottom of each cup with a ballpoint pen, and thread the string through the hole. The paper clip should be on the inside of the cup.
3. Tie the other ends of the strings to a hanger, and tape each knot in a corner.
4. Hold the cups and clang (hit) the hanger against a desk or table a couple of times. What sound do you hear? Can you see or feel the hanger vibrating?
5. Now, hold the cups up to your ears. Bend at the waist and clang the hanger again. Be sure you keep the cups on your ears while the hanger hits the desk.

Here's more about sound:

Sound is vibration. When something vibrates (shakes), it moves the molecules around it and makes sound waves. Sound waves travel through gases (like air), liquids, and solids. The speed of sound is super fast! Sound waves travel about 767 miles per hour through the air.
Size Wise

People come in all shapes and sizes. Some people, for example, are very big, or taller than average. To find clothes that fit them, they may shop in special stores or in special sections of department stores. People who are very short or thin may also need to shop in stores that have clothes in their special sizes.

There are many different body types -- short, tall, big, small, and average. The important thing is not how you look; it's that your body is healthy. Try this experiment that keeps track of your body's individual shape!

Let's measure from head to toe!

Here's what to do:

1. Do this activity outside with a friend. Stand against a brick wall or lie on the sidewalk with your arms spread out to the side.
2. Have your partner mark your measurements with chalk. Have him or her mark where your chin is, your waist, the top of your leg, your elbows, fingertips, your knee, your height, etc. If you use a wheelchair, or if you prefer to sit, your partner can use a tape measure to measure you.
3. Measure the distances between all of these lines. Record your results. 
   What number did you record for the distance from your elbow to your fingertips? How does that compare with the distance from your knee to the floor?
4. Compare other lengths of your body. Try to figure out how many heads high your body is.

Here's more about your body:

You have over 200 bones in your body, and when they grow you grow! How often do you grow out of your clothes? Probably less often now than when you were younger! Babies grow really fast. A baby that is 20 inches long at birth can grow 10 more inches in the first year! That's half of his or her length in one year!

Everyone is different, but by the age of 5, most people have grown at least half of the height they will be as an adult. Then, growth slows a little, but you get another burst right before your teen years. Your body keeps growing taller right up into your early twenties!
Citizen Science

Citizen science projects are research collaborations between scientists and volunteers that welcome public participation to help collect and sort scientific data for ongoing scientific research projects. To get started, first check out SciStarter at https://scistarter.com/index.html, where you can get a basic overview about citizen science and find, join, and contribute to science through more than 1,100 formal and informal research projects and events. These activities range from single-day events at a specific time and place to projects you can take part in independently from your own neighborhood or even in the car while traveling on a trip.

Here are just a few of the citizen science projects you might find there that are looking for volunteers:

**Globe at Night** [https://www.globeatnight.org/](https://www.globeatnight.org/)
Globe at Night, run by the National Optical Astronomy Observatory, is an international citizen-science campaign to raise public awareness of the impact of light pollution. It asks citizen-scientists to use their computer or smart phone to measure & submit night sky brightness observations on one of several moonless nights a month. Participants will compare how many stars they can see in a constellation (such as Cygnus in August and September) to how many they should be able to see.

**NASA GLOBE** [https://www.globe.gov/](https://www.globe.gov/)
The Global Learning and Observations to Benefit the Environment (GLOBE) Program is an international science education program that provides students and the public with the opportunity to participate in data collection and make a meaningful contribution to the understanding of the Earth system and global environment. GLOBE connects students, teachers, scientists, and citizens from various parts of the world to conduct real, hands-on science about their local environment. In the last year, the GLOBE participants have measured temperatures during the solar eclipse and looked at clouds. Currently, they’re running a program asking for citizen science help in mapping, counting, and identifying mosquito larvae found in breeding sites.

Launched in 1998 by the Cornell Lab of Ornithology and National Audubon Society, the Great Backyard Bird Count was the first online citizen-science project to collect data on wild birds and to display results in near real-time. Usually held in February each year, this is an annual four-day event during which bird watchers count birds to create a real-time snapshot of where birds are located around the world.

**Project Budburst** [https://budburst.org/](https://budburst.org/)
Project BudBurst monitors plants as the seasons change. These observations are used by scientists to help better understand how plants are responding to changing climates. You can view photos of local or regional plants, with accompanying information about each plant, or search for invasive, poisonous, or endangered plants. The primary function, however, is to let people report the developmental stages of plants in their community. The data are used to develop plant distribution maps, calendars of when plants are blooming, announcements of where to view fall colors, etc.

*Learn more about citizen science by checking out the Ten Principles of Citizen Science from the European Citizen Science Association at [http://bit.ly/2s300pb](http://bit.ly/2s300pb).*